SECURING AMERICA'S ENERGY FUTURE

Majority Staff Report

To

Committee on Government Reform
Chairman Tom Davis

And

Subcommittee on Energy and Resources
Chairman Darrell E. Issa

Committee on Government Reform
US House of Representatives

May 8, 2006

Findings

No other issue is as central to the continued well-being of the United States as is energy security. During 2005 the Subcommittee on Energy and Resources held nine oversight hearings on energy-related issues. We feel it is imperative to issue this report to advance the discussion on energy policy and craft government policies that will assure our continued economic growth and insulate US foreign policy from coercion by producers of oil and natural gas. President George W. Bush's *Advanced Energy Initiative*, outlined in the 2006 State of the Union, will be one of a number of steps in reducing our dependence on petroleum and ensuring our energy security.

At the same time we reassess our energy security, we must take note that we are in the beginning stages of a clean energy revolution. Alternative and renewable sources of energy are becoming more mature and economically viable. We have realized the mistake of the *de facto* moratorium on the construction of new nuclear generating plants, with the "rediscovery" that nuclear reactors provide an incredible amount of power that is ultraclean. Clean coal plants are moving forward. The automobile market is currently undergoing a renaissance with the market penetration of gasoline-hybrid cars and alternatively-fueled vehicles gaining popularity. Highly efficient and clean diesel cars will also soon come to market. In addition, hydrogen power is steadily advancing with great promise.

We urge that the report and its findings be read in the context of a dramatically altered world energy supply and demand situation, as well as a fundamentally changed geopolitical environment. To fully realize energy security for the long-term, the clean energy revolution must come to fruition over the next several decades. This will require a greater level of coordination between policymakers, businesses, public-private partnerships, and American consumers. We acknowledge that some will suggest that "market forces" will correct the current situation and further government intervention is not necessary. Indeed, private investment in the energy sector must be encouraged not only in the US but in other countries. However, in our view the energy crisis is potentially an economic and national security threat of such magnitude that governmental action is necessary to "provide for the common defense" and the "general welfare" of the United States.

The findings of the report are:

1. Unlike previous periods of high prices and price volatility in petroleum markets, this one is demand-driven and not caused by supply restrictions instituted by producers or political upheaval.

2. Because tight global market conditions are demand-driven with little or no spare production capacity, the US is more vulnerable to a catastrophic supply shock, especially considering the current geopolitical environment.

3. The solution is not an "either or" choice between promoting production and promoting conservation. The US must pursue both options.

4. More than two-thirds of oil consumed in the US is consumed by the transportation sector, mainly cars and trucks. To reduce US dependency on oil, effective demand-reduction policies must focus on this sector.

5. Corporate Average Fuel Economy standards must be strengthened to reduce oil demand and assure the competitiveness of domestic manufacturers. It is the federal government's responsibility to set adequate standards, yet fuel economy has stagnated for the last 20 years. By not upgrading standards, the government has contributed to American manufacturers losing the competitive edge against foreign competition.

6. Alternative transportation fuels, renewable energy, and advanced technologies such as clean coal and next generation nuclear must be aggressively pursued.

7. To enhance competitiveness and protect American jobs, natural gas must not be used for baseload electricity generation, nor for new generating capacity. Natural gas should be reserved for industries that use it as a feedstock or for primary energy—and cannot substitute for it by fuel-switching.

8. Nuclear energy must become the primary generator of baseload electricity, thereby relieving the pressure on natural gas prices and dramatically improving atmospheric emissions.

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Energy Security in Transition

1.1 Introduction

In the same year that the landmark, omnibus Energy Policy Act of 2005 was enacted, increased imports of oil and gasoline, tight energy markets, high fuel prices, and the effects of Hurricanes Katrina and Rita spurred policymakers to reassess what energy security means for America in the 21st Century.

Economic growth in the US is the driving force in the global economy. The US economy is much more efficient in using energy than in years past, due in large part to energy conservation and fuel-switching actions in the 1970s and early 1980s. Despite these improvements, the US is more dependent on increasingly expensive oil than ever before. Demand continues to inexorably increase. In addition, the US price of natural gas has been at record levels to meet record demand, in large part due to natural gas fueling virtually all new electricity generation plants constructed since the mid-1990s.

The volume and proportion of imported oil and gasoline also continues to rise in the US. Similarly, the volume of imports to meet demand is escalating for other countries experiencing robust economic growth, particularly in Asia. With increasing global competition for oil and natural gas at a time when there is very little spare world production capacity, countries such as China and India are becoming increasingly aggressive in pursuing bilateral agreements to lock in supplies over the long-term. Many of these agreements involve national producers that are not friendly to US interests. Alarmingly, producer nations such as Russia, Iran, and Venezuela have used threats—and in Russia's case has followed-through on them—of withholding essential supplies to influence geopolitics.

Hurricanes Katrina and Rita demonstrated the vulnerability of US supplies and distribution systems for oil and natural gas. In the immediate aftermath, the US withdrew crude oil from the Strategic Petroleum Reserve, and had to rely on releases from European reserves in the form of finished gasoline and gasoline blending components. Furthermore, the crisis had global implications because production capacity for the global oil and refined products market is razor-thin and specialized. Cascading effects were felt throughout oil consuming nations.

To ensure US energy security, dependence on oil and refined petroleum products must be reduced. While oil products are used for services such as heating, steam generation, electricity generation, and as industrial feedstocks, the major use of petroleum products is for transportation—68.4 percent of oil consumed in the US is consumed by the

transportation sector, mainly cars and trucks.[1] Globally, demand for transportation services is the key driver for oil demand.[2] By increasing the average fuel economy for the US surface transportation fleet, oil demand can be reduced. Domestic auto manufacturers can increase their competitiveness in the US and world markets by manufacturing more fuel efficient vehicles, particularly as governments look to reduce oil consumption through mandatory increases in fuel economy standards or through higher fuel taxes.

1.2 Energy Security

Let us set as our national goal, in the spirit of Apollo, with the determination of the Manhattan Project, that by the end of this decade we will have developed the potential to meet our own energy needs without depending on any foreign energy sources.

---President Nixon, November 1973, announcing "Project Independence"[3]

Energy security is in a state of transition for the United States and the rest of the world. Having energy security means having a diversity of energy supplies at reasonable prices to keep the economy growing, while ensuring that the nation is not overly dependent on specific elements of supply and distribution—whether nations, geographical regions, type of fuel, or infrastructure. The greater the level of dependence, the greater the opportunity for supply shocks to cause economic crisis, and for suppliers to exert political and strategic influence over consuming nations. Recent events have caused a reassessment of energy security. Energy security in practice must now assure the integrity of the whole supply chain and infrastructure, from production to consumer, which will involve more coordination between the private sector and government.[4]

The US has reached a tipping point in finally acknowledging that it is inherently contradictory to pay lip-service to a goal of energy independence while acting under an assumption that crude oil and refined petroleum products will remain perpetually inexpensive.[5] This point was driven home by one witness testifying before the Subcommittee.

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[1] Energy Information Administration, *Annual Energy Outlook 2006*, Year-by-Year Reference Case Tables (2003-2030), Table 2.

[2] Energy Information Administration, *Annual Energy Outlook 2005*, p. 41.

[3] Quoted from *In Search of Reasonable Certainty: Oil and Gas Reserves Disclosure*, Cambridge Energy Research Associates, February 2005, p. 37.

[4] Daniel Yergin, "The Katrina Crisis," *Wall Street Journal*, September 3, 2005.

[5] Many invoke "energy independence" as meeting domestic demand with 100 percent domestically-sourced fuels or resources. The ability of the US or almost any industrialized country to meet 100 percent of domestic energy needs without imports is unrealistic. The utility of such a policy is questionable considering the marginal benefits of moving from a high proportion of domestic sourcing to an absolute

> *The current situation in US oil and gas can be seen in the context of a fulcrum point. The 20th Century was one in which the US economy was driven by abundant cheap domestic oil and gas. The 21st Century will be driven by scarcer, more expensive, imported oil. The current priorities of US consumers and politicians are lagging the realities of the future, which are all too visible in the present energy crisis.*
>
> ---Mr. Paul Sankey, Sr. Energy Analyst, Deutsche Bank[6]

There must be a change in the energy policy outlook. Policymakers in the US must consider energy security in terms of balancing risk across an *energy portfolio*. No longer can energy security solely involve ensuring a diversity of foreign supplies of oil while taking precautions to deal with interruptions in crude oil production. The US must pursue a diversity of energy resources, and both supply-side and demand-side measures must be pursued in order to achieve a balance.

Policymakers and the public must also acknowledge that conservation and "fuel switching" to renewable energy sources alone cannot begin to meet US energy needs, just as opening up the Arctic National Wildlife Refuge and other areas to oil development will not satisfy demand increases in the future nor noticeably lower prices. By framing energy policy in terms of an "either or" choice between petroleum and renewables, we lose sight of the fact that these demand and supply-side policies can decrease US vulnerability, and should be pursued as part of the portfolio.[7] However, even taking into account these potential improvements, the current energy mix does not meet long-term US needs and minimum requirements for energy security.

Industries, consumers, policymakers, and public-private partnerships must consider a variety of factors in energy portfolio allocations, including: cost, efficiency, environmental burden, domestic production capacity, and geographic source. Not all sources will be economical in the short or medium-term. The US must learn from the experience of the 1970s and early 1980s that the eventual abandonment of government-backed investment for new technologies in the face of lower prices—while it made sense

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level—e.g. escalating from 60 to 85 percent to 100 percent without consideration of cost, efficiency, or source emissions. Furthermore, some imports of fuel, such as from the US-Russia Megatons to Megawatts program, are clearly beneficial and enhance US and world security. Under the program, uranium fuel from recycled former-Soviet nuclear weapons is used to generate electricity, powering one in ten US homes. To date almost 10,750 nuclear warheads have been eliminated. All things considered, the energy situation must be viewed as a continuum between total energy dependence on one end and 100 percent independence on the other.

[6] Written testimony of Mr. Paul Sankey, Deutsche Bank, for the House Government Reform Subcommittee on Energy and Resources Hearing, *Petroleum Refining: Will Record Profits Spur Investment in New Capacity?* October 19, 2005.

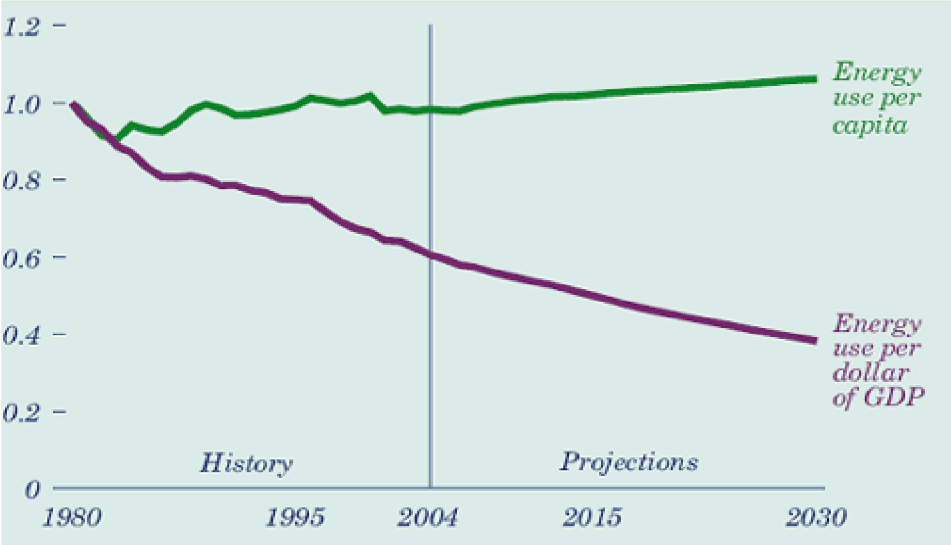
[7] While not reducing oil intensity, drilling in ANWR would contribute substantially to correcting the US foreign trade deficit; Ian Parry W.H. Parry and J.W. Anderson, "Petroleum: Energy Independence is Unrealistic," *Resources* Winter 2005, p. 15. Also, the US has substantial natural gas reserves that are off-limits to exploitation on the Outer Continental Shelf, in the Rocky Mountain region from Montana to New Mexico, and Alaska.

in market terms—was not an overall benefit to US energy security. Policymakers must continue to provide incentives for technologies such as advanced nuclear, clean coal, and renewables over the medium and long-term.

1.3 The US Economy, Oil Intensity, and Prices

Economic growth in the US is the driving force in the global economy. While the US consumes 25 percent of the world's energy, it accounts for 32.6 percent of the world's GDP.[8] The US economy is much more efficient in using energy than in years past, due in large part to energy conservation and fuel-switching actions. Since 1970, the amount of energy needed to produce each dollar of US GDP has been reduced by 49 percent.[9]

US Energy Intensity Per Capita and Per $ of GDP



Source: EIA Annual Energy Outlook 2006 (Early Release)

Despite the decline in oil intensity, the US is more vulnerable to supply shocks and strategic manipulation of energy supplies than at any time in recent memory. Because many of the hard choices were put off once prices dropped in the past, corrective actions require a fundamental reassessment of the direction of energy policy. Record-high global demand, the concentration of oil reserves in the Middle East, and US reliance on the Gulf of Mexico for production and distribution of fuels contribute to America's vulnerability.

[8] GDP is calculated from *World Development Indicators*, World Bank, Country GDP 2003.

[9] Energy Information Administration, *Annual Energy Review 2004*.

1.3.1 Hurricanes Katrina and Rita

Prices for crude oil, gasoline, and natural gas were at or close to historic highs before Hurricane Katrina made landfall on August 29, 2005. On the spot markets, US wellhead prices for natural gas were quintuple what they were just ten years earlier, and both crude oil and gasoline prices were 3.6 times higher for the same period.[10]

Hurricanes Katrina and Rita delivered a devastating blow to the nation's energy infrastructure because of the Gulf of Mexico's central role in production and refining. According to the Federal Reserve Bank of Dallas' Houston Branch, 26.4 percent of the nation's domestic crude oil production and 21.3 percent of natural gas production takes place in the Gulf of Mexico. Almost 40 percent of the nation's crude oil refining capacity is located on the Gulf Coast.

The Gulf Coast had only just recovered from the effects of 2004's Hurricane Ivan, which heavily damaged underwater pipeline infrastructure. According to the Department of Interior's Minerals Management Service's last 2005 report on hurricane-damaged energy infrastructure in the Gulf of Mexico, shut-in oil production on December 29, 2005, was equivalent to 27.4 percent of the daily oil production in the Gulf of Mexico. The cumulative shut-in oil production for the August 26-December 29 period was equivalent to 19.9 percent of the yearly production of oil in the region. Shut-in gas production was equivalent to 19.5 percent of the daily gas production in the Gulf of Mexico. The cumulative shut-in gas production for the August 26-December 29 period equaled 15.4 percent of the yearly production of gas in the region.[11]

Immediately after Katrina struck, the Secretary of Energy approved loans of crude oil from the domestic Strategic Petroleum Reserve (SPR). However, only about one-third of SPR crude that was offered was in fact loaned, because there was not enough undamaged refining capacity to process it. Furthermore, following Rita one-third of the nation's oil refining capacity was offline. As of November 1, almost 5 percent of the nation's refining capacity was still shut-down. Because the refineries were already operating at full tilt, gasoline prices hit record levels. According to the Congressional Research Service, refined product supplies were replaced by the release of 30 million barrels of gasoline, middle distillate and other products from the strategic reserves of member nations of the Organization for Economic Cooperation and Development who are International Energy Agency members.[12] To facilitate the refined product response, the Environmental Protection Agency temporarily waived Clean Air Act requirements so that any available gasoline could be used in any regional market.

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[10] Crude oil prices refer to West Texas Intermediate and gasoline prices are for New York Harbor conventional gasoline.

[11] MMS measures from August 26 as infrastructure and equipment were taken offline and shutdown prior to the hurricanes as part of emergency protection procedures. "Shut-in" refers to production that is offline.

[12] CRS Report for Congress, *Oil and Gas Disruption from Hurricanes Katrina and Rita*, October 21, 2005.

The hurricanes' ongoing impacts have made already tight markets worse, contributing to persistent high prices. Sustained high prices for oil and natural gas may prove to be a drag on productivity and economic growth in the US. Slowed productivity growth decreases wage growth and increases the unemployment rate. Businesses and consumers save less and borrow more, resulting in higher interest rates and increased inflation. Higher utility bills result in less discretionary spending at the household level.

1.4 Global Markets and Geopolitics

Today the United States faces very different markets for natural gas, crude oil, and refined petroleum products than those of the preceding two decades. In regard to natural gas, a tightening of the balance between supply and demand, first evidenced in 2000, has led to higher and more volatile prices. Hurricane Katrina has only added to this picture by delivering a real shock, driving prices further up and creating considerable anxiety about the immediate and future supply. The run-up in natural gas prices, which has been under way for several years and has occasioned much anxiety in the US, was predictable in the sense that its underlying cause—the inability of continental production to keep pace with demand—has been recognized for many years. Since 2003, Cambridge Energy Research Associates has routinely warned that higher and more volatile natural gas prices will become the norm for the North American market.[13]

Just as sustained higher prices were predictable, so has been the industry response to those prices. A surge in investment by companies seeking to bring new supplies, both from continental sources and imported in the form of liquefied natural gas (LNG), is well under way. However, meaningful growth in supply, mostly from LNG, will not be realized for a few more years. As a result, significant, sustained price relief will not come to the United States before 2008 at the earliest, and only then if LNG development is substantial considering it currently supplies less than 3 percent of natural gas consumed by the US.

Unlike the market for crude oil, natural gas markets are fragmented according to the limited number of LNG terminals or pipeline connectivity—hence Russia's recent gambit to exert pressure on the former Soviet bloc countries that depend on it for their critical natural gas needs. Although progress is being made, there is not yet a truly global spot market for LNG although more consuming countries are seeking to build regasification terminals to receive LNG. In 2004 almost 12 percent of a nearly 20 billion cubic feet per day global LNG market was sold on a spot basis; the rest of the market is dominated by long-term contracts.[14] To illustrate, the prices paid for natural gas in different regions vary widely depending on government subsidization, usage, and availability.

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[13] Written Testimony of Mr. Michael Zenker, Cambridge Energy Research Associates, for the September 14, 2005 hearing, *Meeting America's Natural Gas Demand: Are We in a Crisis?*

[14] Written response from Mr. Michael Zenker, to Chairman Issa's followup question from the September 14, 2005 hearing, *Meeting America's Natural Gas Demand: Are We in a Crisis?*

Natural Gas Costs around the World, 2005
($US per million BTUs)

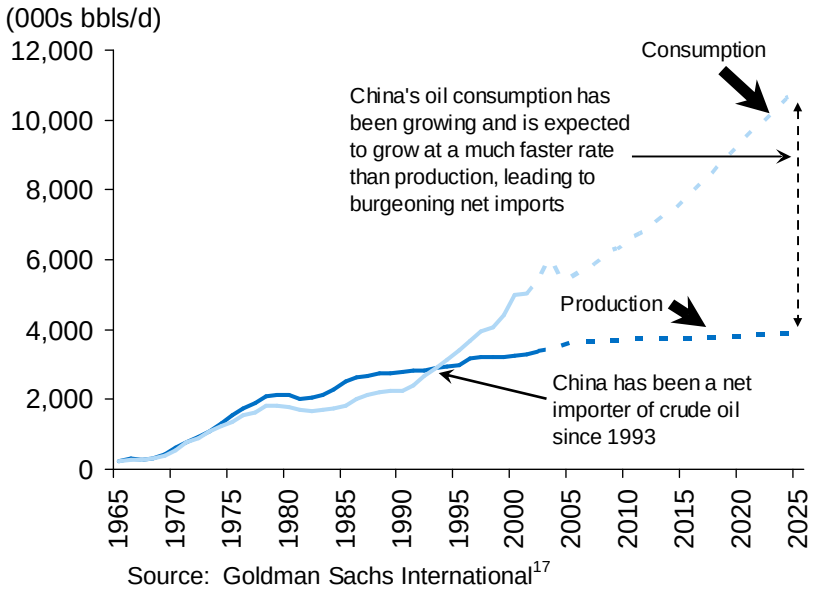
Source: American Chemistry Council

Unfortunately, many consumers in the US feel the burn of high natural gas prices twice. Not only do they shoulder escalated costs through their natural gas bills, but they are hit again through higher electricity bills due to natural gas-fired intermediate and baseload production. Domestic production can no longer satisfy demand to the point where price stability is anywhere in the near future.

In contrast to natural gas markets, crude oil and gasoline are tradable commodities in a highly integrated global market. High demand growth for oil and refined petroleum products has led to a tightening of supplies and high prices. Market fundamentals are likely to change little in the next few years, with a lack of spare production capacity and robust commercial inventories. Unlike previous periods of price volatility, this one is demand-driven and not caused by supply restrictions instituted by OPEC or political upheaval. With the additional complication of the hurricanes' supply shock felt throughout the world, global markets have been knocked off an already precarious balance between supply and demand.

Demand projections for China alone are staggering. It was the source of 40 percent of world oil demand growth from 2001 to 2005. China's annual electricity consumption has

recently been climbing at a more than 15 percent rate.[15] In addition, using more conservative estimates than Western analysts, the Chinese government predicts the number of cars and trucks in China to reach 130 million by 2020, rising from less than 20 million in 2000.[16] The amount of gasoline or diesel fuel required to meet these estimates will be enormous. China is now the second largest oil consumer and importer in the world.



Source: Goldman Sachs International[17]

India is expected to follow closely in the footsteps of China in regard to energy use. India, with a current population of 1.1 billion, will experience strong annual increases in demand for oil and natural gas. Oil consumption is forecast to increase 24 percent by 2010, and Indian demand for natural gas will increase 5.1 percent annually. According to the US Energy Information Administration (EIA), Asian developing countries will lead the world in energy consumption growth as their economies become more advanced and populations continue to rise; EIA forecasts the region will account for 45 percent of the total increase in world oil consumption through 2025.[18]

1.4.1 A New Competition for Energy

In a post-Cold War world, these factors have led to new strategies, the pursuit of new alliances, and aggressive tactics by both petroleum producing and consuming nations.

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[15] Energy Information Administration, *Country Analysis Brief: China*, August 2005.

[16] *China Daily*, "Vehicle Market Growth Imposes Challenges," May 11, 2004.

[17] Written Testimony from Ambassador Robert Hormats, Vice Chairman Goldman Sachs International. Testimony before the House Government Reform Subcommittee on Energy and Resources Hearing, *America's Energy Needs as Our National Security Policy*. April 6, 2005, p. 3.

[18] Energy Information Administration, *International Energy Outlook 2005*.

Competition for resources can certainly be extended to other fuels besides those that are petroleum-based. The global supply network and players are shifting, indicating a change in the world energy map and geopolitics.

Furthermore, producer countries are using control of petroleum supplies as a tool—or weapon—to coerce other nations or to advance their strategic interests. Venezuela has threatened to withhold crude oil from the American market and then sold home heating oil at cut-rates to some US cities in an attempt to undermine Administration foreign policy. President Chavez has also pressured international petroleum companies into renegotiating existing agreements for production in Venezuela, with the implication that companies that will not cooperate may have oil or gas concessions voided or expropriated. Russia jailed the CEO of privately-owned energy giant Yukos, broke the company up, and sold off its oil subsidiary to state-run company Rosneft. Iran has repeatedly threatened to withhold oil from the world market should sanctions be imposed as a result of Iran's ill-advised program to enrich uranium. In addition to grave security concerns, using energy supplies as a threat provides a powerful disincentive to private investment. This is already being witnessed in Venezuela and Russia, where necessary upgrades and maintenance of equipment are not occurring due to a lack of investment.

China is using increasingly aggressive tactics to secure long-term access to oil and natural gas. Chinese state-owned companies have sought to strengthen China's hand in a new and extended "great game" of geopolitics through regional agreements and acquisitions.[19] The China National Petroleum Company has acquired petroleum concessions in Kazakhstan, Venezuela, Sudan, Iraq, Iran, Peru, Ecuador, and Azerbaijan. The China Petroleum Corporation is seeking to purchase overseas upstream assets. State-run oil companies from China, the Philippines, and Vietnam have signed an agreement to jointly conduct a seismic survey in the South China Sea to systematically determine energy potential in the area. China and Canada are promoting cooperation in oil sands production. In October 2005, China National Petroleum Corporation successfully sealed a deal for PetroKazakhstan. The first fuel has already been delivered through the 1,800-mile Atasu-Alashankou pipeline between Kazakhstan and China. The pipeline will also transit Russian oil to China from western Siberia. Finally, China recently completed a number of energy agreements with Russia, including a joint venture between state-owned companies.[20]

China has also not hesitated to seek out sources controlled by governments hostile to US interests. In addition to expansion of Chinese influence, it is an issue of great importance because these states may view China as a "buffer" against what they perceive as US aggression.[21] China receives almost 15 percent of its oil from Iran and is the largest buyer of oil from Sudan. In December 2004 Venezuelan President Hugo Chavez signed

[19] The first "great game" refers to the conflicts and maneuvering to control the resources of Central Asia during the 19th Century.

[20] *Stratfor Situation Reports*, 3/22/06, 8/26/05, 8/22/05, 3/14/05.

[21] *Stratfor*, "China's Overseas Expansion Strategy," 4/17/03.

eight agreements in Beijing that prepared the foundation for granting Chinese oil companies preferential access to oil and gas projects in Venezuela, including exploration and production, and the construction of new pipelines, refineries, and petrochemical plants. Both China and India have entered long-term agreements with Iran for natural gas supply, and both countries have taken equity stakes in Iranian natural gas production. Chinese and Indian companies recently submitted a joint bid to obtain a 38 percent share of a Syrian petroleum company.[22]

1.4.2 The Resurgence of State-owned Companies

National or state-owned oil companies are pursuing global contracting and partnership opportunities that were previously the reserve of international oil companies. This development is of particular concern since government-controlled companies already manage 72 percent of the world's oil reserves, 55 percent of gas reserves, and more than half of current world oil production.[23] These agreements demonstrate how national oil companies are turning away from their traditionally insular roles and are pursuing contracting opportunities that were previously the reserve of international oil companies. The lack of transparency in state-owned operations and bids for contracting vis-à-vis private international oil companies is a concern. By having state treasuries behind them, state-owned companies may operate at a loss while private corporations do not have that option. With much of the world's proven oil reserves in countries with access controlled by national ministries or national oil companies, international oil companies are at a decided disadvantage.

1.4.3 Developments in Russia

Nowhere has the wielding of political power in energy markets by governments and state-owned companies been more in evidence than in Russia. Besides the well-known Yukos affair, Gazprom has used its supply of natural gas in an attempt to subvert Ukrainian autonomy from Russian influence. Unlike crude oil, there is a very limited international spot market for natural gas, and supplies are not easy to come by. Russian government officials and Gazprom executives acted in concert to pressure the Ukraine into paying exorbitant prices for natural gas. A compromise agreement to phase-in a less damaging but still high price was reached, but only after Russia reduced the flow of natural gas to the Ukraine, affecting greater Europe. More than one-quarter of natural gas consumed by European Union countries is imported from Russia—almost 40 percent in all European countries—and 80 percent of that transits Ukraine.[24] Since then, a number of Russia's neighbors have scrambled to negotiate new agreements with Russia or to seek alternative arrangements, most likely with varying rates of success. In essence, they have

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[22] *Stratfor Situation Reports*, 11/29/05, 12/2704.

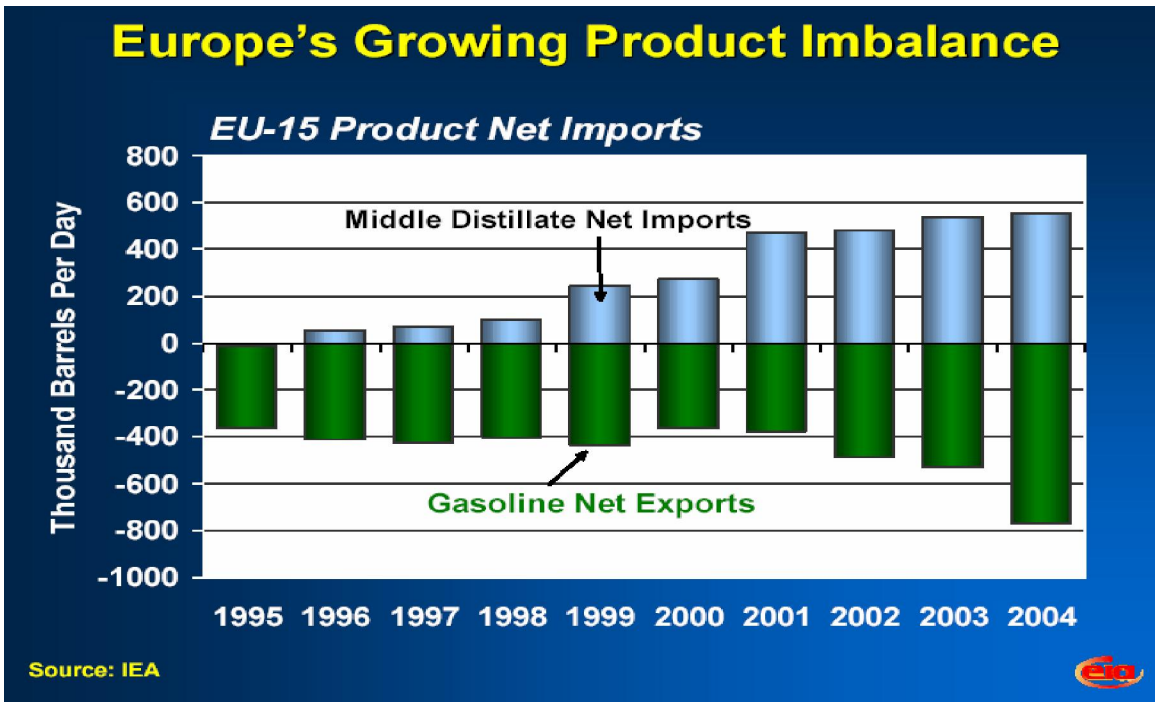
[23] Testimony of Mr. Frank Verrastro, Director of the Energy Program, Center for Strategic and International Studies, before the Senate Committee on Energy and Natural Resources, February 3, 2005.

[24] *Stratfor*, "EU: Exploring Its Energy Options," 1/03/06.

been forced to make a choice between being firmly in Russia's sphere of influence or moving closer to greater Europe with doubtful prospects for a near-term solution to their energy problems.

Also of concern is the "Atlantic Basin" or "Russian Cascade" in the global petroleum refining balance. As the members of the European Union have transitioned from a predominantly gasoline-fueled surface transportation fleet to one that is diesel-powered, European refiners have not met the diesel, or middle distillate, demand. Instead, these refiners have lagged the transition and, rather than rapidly converting refinery production to meet European demand, they have chosen to capitalize on more advantageous profit opportunities by producing and exporting gasoline to the US. More than 10 percent of gasoline consumed in the US comes from imports, and Europe supplies most of the shipments. The Northeast is particularly dependent on imports to meet demand, accounting for almost 90 percent of US gasoline imports.[25]

What makes this arrangement work are Russian exports of diesel fuel to meet Western Europe's demand. Should events lead to Russia reconsidering this arrangement, or render it unable to export diesel to Europe in the needed quantities, a shock would "cascade" through the system to US gasoline markets, resulting in tumultuous global markets until the structural disequilibrium was corrected.



Source: EIA from International Energy Agency data

[25] Energy Information Administration, *Short-Term Energy Outlook: Summer 2005 Motor Gasoline Outlook*, April 2005, p. 11.

Fortunately, a negative cascade has not reverberated through the system. In fact, the imbalance helped the US cope with the short-term aftershock of Hurricanes Katrina and Rita because Europe had enough gasoline through increased production and reserves to help meet US demand. This will surely not be the case for the long-term, however.

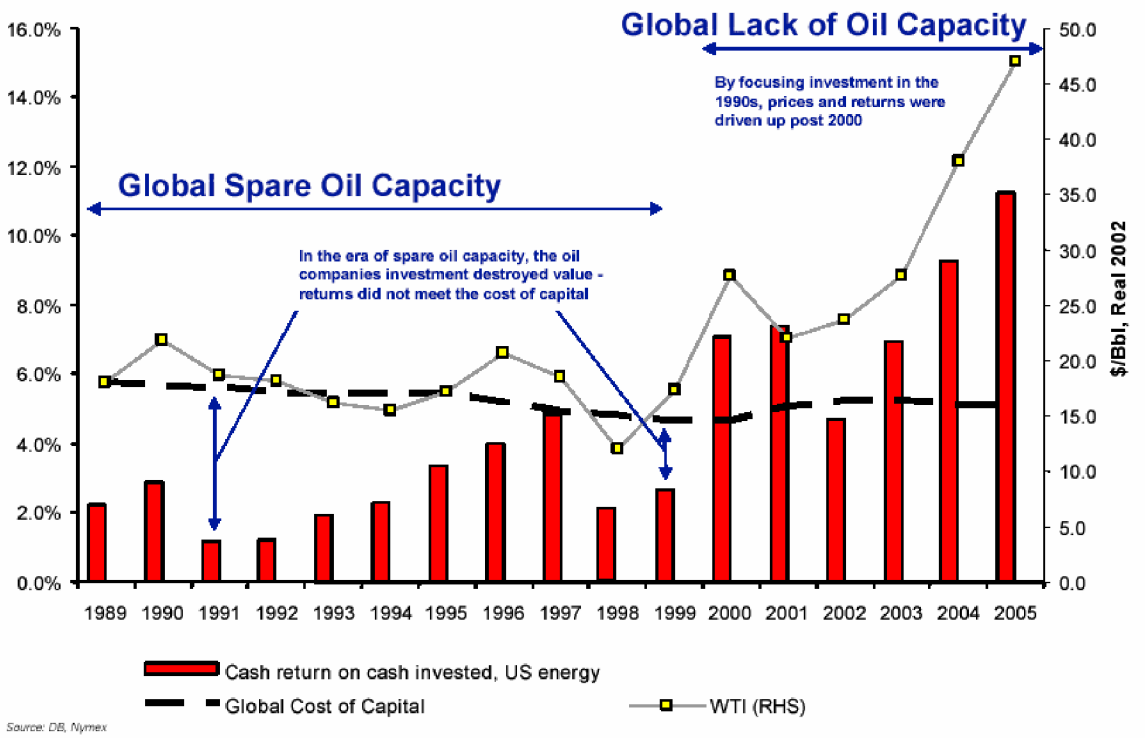
1.5 Tight Global Refining Markets

The complex balance in refined products trade is of concern because of very tight global refining markets. There is very little spare refining capacity in the world system—approximately 3 to 4 percent at present according to one Subcommittee witness.[26] In other words, existing refineries are operating flat-out, and are taken offline only for absolutely necessary maintenance. Sudden or even incremental increases in demand result in an outsize impact on prices because there is little or no surplus capacity to meet the demand surge. Record profits have been the result, but the last two years earnings have not been the norm for the industry. The situation, however, must be changed if record profits due to a dangerous lack of spare capacity are not to become the rule rather than the exception.

Excess capacity has been wrung out of the system since the 1980s. Record profits in the late 1970s and early 1980s led to vast overexpansion in the global oil industry. In 1986 there was 100 percent spare capacity in the industry.[27] The refining industry followed with years of below-average earnings and lost money as recently as 2002. Globally, return on investment for the oil industry was often below the cost of capital for much of that period.

[26] Written testimony of Mr. Thomas O'Connor at the Subcommittee's October 19, 2005 hearing.

[27] Written testimony from Mr. Paul Sankey at the Subcommittee's October 19, 2005 hearing.

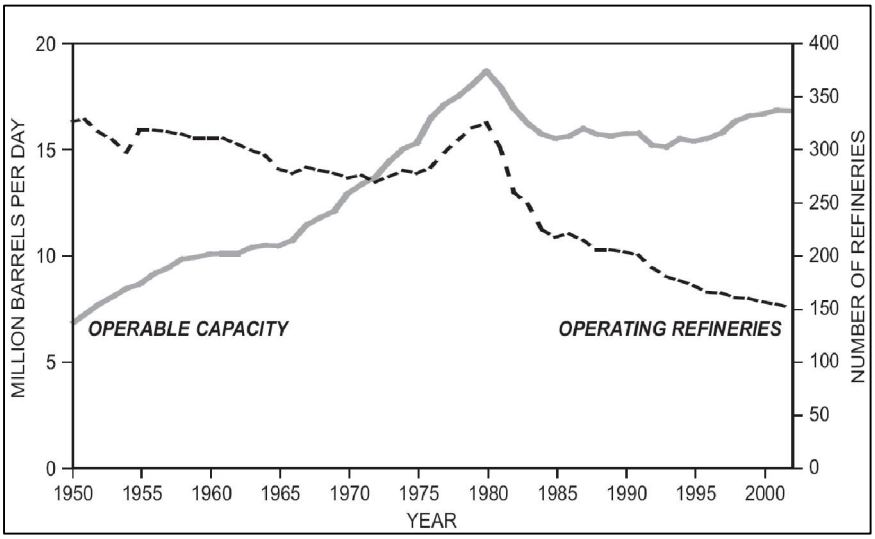


Source: Written testimony of Mr. Paul Sankey, Deutsche Bank, for the October 19, 2005 Subcommittee Hearing, *Petroleum Refineries: Will Record Profits Spur Investment in New Capacity?*

To that end, the US refining industry has increased the average size of existing refineries, closed smaller inefficient operations, and stepped-up production levels from their consolidated capacity. Consequently, US refineries now do more with less. No new refineries have been built since 1976, and additions in capacity are done through expansions of existing refineries because of environmental regulations and because it is cheaper. A large new refinery built in the US would cost between $5 and $7 billion dollars and more than five years to build—all before a dollar is earned.[28] Refining companies are reluctant to upset the current balance between supply and demand now that profits seem assured for the future.

[28] Testimony of Mr. Thomas O'Connor at the Subcommittee's October 19, 2005 hearing, *Exhibit 16.*

Change in US Refinery Capacity Relative to Number of Refineries



Source: Federal Trade Commission, July 2005.

The global situation is much the same. New refineries are planned but new capacity is not expected to provide much of a cushion versus increased global demand. Industry experts forecast that most of the new refining capacity will be built overseas and co-located with petrochemical manufacturers to achieve cost-savings and economies of scale.

1.6 Targeting Foreign Oil Dependency

US oil demand is steadily growing while domestic supplies are dwindling, forcing the US to rely on imports for almost 60 percent of our consumption. Fifty years ago the US produced half of the world's oil, and today we do not produce even half of our own needs. Domestic crude oil production continues to decrease, from a projected 5.5 million barrels in 2006 to 4.57 million barrels in 2030.[29] EIA forecasts dependence on petroleum imports will increase to 68 percent by 2025.[30] By 2030, forecasts indicate the transportation sector will comprise 74 percent of US petroleum consumption.[31]

Dependency on imported oil has a number of decidedly negative effects. It makes the US more vulnerable because many of the countries that hold the greatest reserves are not friendly to US interests. The greater Middle East will continue to be the low-cost and

[29] Energy Information Administration, *Annual Energy Outlook 2006*, Reference Table 11.

[30] Energy Information Administration, *Annual Energy Outlook 2006*, p. 101.

[31] Energy Information Administration, *Annual Energy Outlook 2006*, p. 95.

dominant petroleum producer for the foreseeable future, ensuring its geopolitical importance. While usually willing to sell to the highest bidder, suppliers such as increasingly belligerent Venezuela and Iran have threatened to curtail sales or cut off supplies.

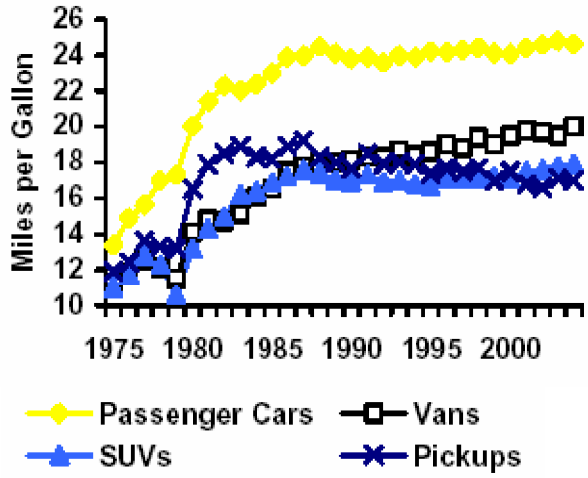
Reliance on imported oil has important implications for the balance of payments and the US trade deficit. At $50 per barrel—the price of crude when the Subcommittee had its first hearing in March 2005—the US sends nearly $600 million each day to foreign sources, which are often to state-owned oil companies in countries that are hostile to us. Some of the funds are likely to be used to fund activities counter to US interests or even to fund terrorism. The US "oil bill" accounts for more than a third of the annual trade deficit the US currently runs.[32]

The US is more dependent on imported oil than in the past, despite periodic calls for national initiatives to wean our appetite for foreign crude in the wake of the 1973 Arab Oil Embargo, the 1979 Iranian Revolution, and the Iraqi invasion of Kuwait and the Persian Gulf War in 1990-1991. These crises were supply shocks to the US economy that caused a rapid reassessment of energy policies and consumer behavior. The pattern has been for policymakers and consumers to make progress in reducing demand—or demand growth—through conservation, efficiency, and fuel-switching measures. The response lasts only as long as prices are high or changes remain mandatory. The same effect can also be seen in Corporate Average Fuel Economy Standards. After a period of steady improvement, continually falling gasoline prices resulted in a flat-lining of fuel economy due to relaxations of standards and manufacturers responding to consumer preferences for purchasing large new vehicles.[33] This recurring pattern must be broken.

[32] Written testimony of Mr. Paul Portney, President of Resources for the Future, March 16, 2005 Subcommittee Hearing, p. 3.

[33] The Department of Transportation announced new CAFÉ standards for light trucks and the heaviest SUVs on March 29, 2006. The light truck targets will increase from 21.6 to 24 miles per gallon by 2011.

Sales-Weighted On-Road Fuel Economy by Vehicle Type, 1975-2004 Model Years



Source: Energy Information Administration, *Household Vehicles Energy Use: Latest Data & Trends*, November 2005. EIA used the US EPA's *Fuel Economy Trends 2004* as the data source.

1.6.1 Policy Options: Revising CAFE

The US has three primary options for reducing demand in the transportation sector: widespread development of alternative fuels, increasing gasoline taxes, and aggressively revising CAFE standards. Alternative fuels and ethanol are undergoing welcome and rapid development, but their gasoline-reduction impact will not be realized on a national scale until well into the future. Sufficiently raising gasoline taxes to greatly reduce demand would harm the economy, disproportionately impact rural areas, and is not politically feasible.[34]

Policymakers and regulators need to aggressively revise CAFE standards and the design of the program. Fuel economy has stagnated since 1985, greatly contributing to US oil dependence since the transportation sector consumes the bulk of oil. US industry found it easier to lobby against CAFE increases as an impediment to business operations than to keep making strides in fuel efficiency. This was a strategic mistake; CAFE is about US competitiveness, and the government must reassess its role in preventing shocks to US industry by enhancing efficiency rather than pursuing myopic policies protecting the status quo.

Advances in automotive technologies in the domestic market have gone to increased horsepower and vehicle size. While short-term profits were realized by concentrating on sport utility vehicles and minivans during times of cheap gasoline, US automakers are

[34] If increases in gasoline taxes at these levels ($1.25 to $2.25 per gallon) were not to harm the economy, at the minimum accompanying tax cuts at equivalent levels would need to be made to counteract the negative effects on consumers and business.

poorly positioned because global oil markets dictate that consumers will not value these vehicles as highly for the foreseeable future. Higher mileage requirements are achievable and cost-effective. Increases in CAFE standards will ultimately make US automakers more—not less—competitive.

One of the most attractive options for revising CAFE is a market system of tradable credits across the automobile manufacturing industry.[35] Under the current system, the sales-weighted average fuel economy of an individual manufacturer's fleet of passenger cars or light trucks for a given model year must be equal to, or greater than, the standard. By allowing a system of tradable credits, car manufacturers have the freedom to design and build the types of vehicles that will bring the most profit, taking into account the market for CAFE credits. Greater efficiencies in the overall domestic market will be reached without requiring each manufacturer to build, market, and sell all types of vehicles. Rather, each manufacturer can focus on its core competencies and design expertise.

1.6.2 Policy Options: Revisiting Strategic Reserves

The effects of Hurricanes Katrina and Rita and forecasts for tight refining markets well into the future require investigating additional options to protect the US economy. To ensure crucial fuel supplies and to avoid economic catastrophe in the event of a supply shock, the National Academies of Science (NAS) should carry out a study on the feasibility and utility of creating strategic reserves for fuels other than crude oil. The Chairman of the Subcommittee has introduced a bill, HR 4043, to charge the NAS with such a study.

The situation for gasoline was especially tenuous following the hurricanes. Although the international strategic reserve system worked, there is no doubt that the US was heavily dependent on imported gasoline for an extended period. It is possible that a worse catastrophe could affect global refining markets, causing a shortfall in supplies of gasoline and gasoline blendstock. Building a reserve could provide the cushion needed to combat skyrocketing prices—and their devastating effects—for a period of time until emergency imports arrive and critical production and distribution infrastructure resume operations.

Designing a working reserve for refined products is much more complicated than designing a crude oil reserve, and would have an effect on the structure of the SPR. Refined products degrade over time and storage is an important consideration. A new reserve's effect on markets and the behavior of the private sector is also of utmost importance. Finally, a gasoline reserve should not be promoted as a way to lower everyday gas prices. The likely effect is that gasoline prices would rise at least a few cents per gallon if a reserve were to be instituted. This increase can be viewed as an

[35] This option has been popularized by the non-governmental, bipartisan National Commission on Energy Policy.

insurance cost against a crushing blow to the US economy caused by a supply shock. The question is then whether a strategic reserve would be worth the cost and who, in fact, ultimately pays for the additional measure of security.

Nuclear Power and Electricity

2.1 Introduction: Nuclear Must be the Primary Source of Generation

I believe the majority of environmental activists… have now become so blinded by their extremist policies that they fail to consider the enormous and obvious benefits of harnessing nuclear power to meet and secure America's growing energy needs. These benefits far outweigh the risks. There is now a great deal of scientific evidence showing nuclear power to be an environmentally sound and safe choice.

--– Mr. Patrick Moore, Co-Founder of Greenpeace[36]

The early release of the Energy Information Administration's *2006 Annual Energy Outlook* provides that the percentage of electricity generated by coal-fired plants will decline slightly by 2020—to 49 from 50 percent—and then increase to 57 percent by 2030. Natural gas will increase to 22 percent by 2020 before falling to 18 percent by 2030 as a result of new coal plants being constructed. Nuclear generation will fall from today's level of 20 percent to 15 percent by 2030. This lopsided ratio will generate higher prices, increase dependency upon LNG imports to supplement domestic natural gas depletion, and perpetuate the release of more harmful emissions produced by coal plants. Realigning policies to ensure nuclear power is the primary supplier of baseload electricity is the only sensible path forward. In addition, a revived nuclear program should revisit the "once through" fuel cycle. Instead, the US should consider recycling nuclear materials with the goal of achieving an innovative "closed loop" fuel cycle. This will make for more efficient use of nuclear fuel, less volume of waste, and less harmful nuclear waste that must ultimately be disposed of in a long-term waste facility.

As nuclear power's share of electricity is forecast to decline in the US, nuclear power is experiencing a resurgence around the world. Nuclear power already supplies a larger percentage of electricity in 17 countries than it does in the US, and the number is expected to grow. As of April 2005, 30 nuclear reactors were being constructed in 11

[36] Written testimony of Mr. Patrick Moore, prepared for the April 28, 2005 Subcommittee Hearing, *The Role of Nuclear Power Generation in a Comprehensive National Energy Policy*.

countries, notably China, South Korea, Japan, and Russia. None are under construction in the US.[37] The United Kingdom, Sweden, and Germany are reviewing their energy policies that unwisely assumed intermittent renewable sources are capable of meeting everyday electricity needs without nuclear power.[38] Still other countries in Europe are considering increasing the scope of their own nuclear programs in response to the recent crisis brought on by Russia's willingness to withhold natural gas from dependent consumers.

Increased nuclear electricity production has several critical advantages over the status quo. It will, among other things, free natural gas supplies for critical uses in manufacturing processes, reduce electricity costs to the consumer, be emission-free, and pave the way for drastically reduced petroleum dependency should next generation nuclear technology be used to produce hydrogen in sufficient quantities to power a critical mass of emissions-free automobiles. Nuclear technology has steadily advanced and companies have designed standard reactor models that can be constructed anywhere in the world, in stark contrast to the existing fleet of aging US nuclear plants that were customized according to each location and permitting process. The switch to nuclear power as the primary source of baseload electricity will not come without a cost; it will necessitate tremendous political support and financial investment from private institutions and the federal government alike. This process will also require time and patience. The federal government has begun to realize this, albeit to a limited extent.

On August 8, 2005, President Bush signed into law the Energy Policy Act of 2005 (EPACT05). EPACT05 calls for novel incentives for private institutions to build and operate nuclear facilities. These benefits include an amendment to the Price-Anderson Act to extend liability protection for private institutions, tax credits for megawatts, an expedited review of reliable and affordable nuclear waste storage, and financial protection for costs incurred due to licensing delays. Congress intends that these incentives spur renewed interest in reactor production.

Despite these new incentives, and notwithstanding the President's Nuclear Power 2010 initiative,[39] the United States is no closer to energy security because the scope of energy

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[37] World Nuclear Association, *Plans for New Reactors Worldwide*, April 2005.

[38] Maturing renewable power sources such as solar and wind are important to US energy security and must be developed. However, most renewables are intermittent in nature and cannot meet baseload demand because there is no way to store this energy. For example, the US National Academies of Science predicts future improvements will only increase the utilization capacity of wind turbines from 30 to 40 percent—meaning they cannot be relied upon to always deliver power when and where it is needed. In the US, EIA forecasts that renewables will not exceed 10 percent of the energy portfolio in the next 25 years.

[39] The Nuclear 2010 program will pay up to half of the nuclear industry's costs of seeking regulatory approval for new reactor sites, applying for new reactor licenses, and preparing detailed plant designs. The program is intended to provide assistance for advanced versions of existing commercial nuclear plants that could be ordered within the next few years. The applications under the Nuclear Power 2010 program are intended to test the "one step," combined construction permit and operation licensing process established by the Energy Policy Act of 1992. Previously it was a two-step, sequential process that did not assure that

policy has been too narrow. Congress drafted EPACT05 to help clear the hurdles impeding new reactor construction. Assuming the 6,000 megawatt increase contemplated by EPACT05 is realized, by 2019 nuclear power's share of electricity generation would actually shrink to only three-quarters that of today—down to 15 percent.[40] For nuclear power to maintain its 20 percent share of the nation's electricity generation, 41 new 1,000 megawatt plants would be needed by 2025. Thus, the incentives do nothing more than to promote reactor construction without stopping the decline of nuclear power's central role in US electricity generation. Similarly, the President's 2010 initiative, referenced in the 2005 State of the Union address, carries only the hope of granting construction permits and operating licenses. It places no obligation upon petitioners to actually build reactors once they receive licenses. In this light, Congress and the Administration must be bolder.

2.2 The US Electricity Outlook

Recent trends suggest that, given current and projected consumption rates, energy demand in the United States will increase at an average rate of 1.2 percent per annum, from 99.7 quadrillion Btu in 2004 to 127 quadrillion Btu in 2025. Likewise, total electricity demand will increase from 3,729 billion kilowatthours (kwh) in 2004, to 5,619 billion kwh by 2030. Coal-fired plants will provide 57 percent of the electricity generated, while natural gas-fired plants and nuclear plants will shoulder 17 percent and 15 percent, respectively.[41] Under present conditions, however, fossil fuels will not allow the United States to satisfy this growing demand in a safe and affordable manner. Natural gas prices are presently at an all-time high, and there is no guarantee of relief as supplies continue to dwindle and expensive, unreliable Liquefied Natural Gas (LNG) imports fill the void.

The electricity outlook is heavily influenced by the 1992 Energy Policy Act (EPACT92), which has had far-reaching consequences. EPACT92 opened access for interstate wholesale bulk power transactions. Simultaneously, it greatly increased the scope of the Federal Energy Regulatory Commission's jurisdiction. While access to wholesale bulk power markets was opened, EPACT92 left it to individual states to determine whether retail access would be opened to competition. New entities were formed to take advantage of industry transformation under EPACT92. New generation companies not subject to price regulation were created and separated from ownership of the grid, which is still regulated in terms of prices.

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constructed plants were granted operating licenses. CRS Issue Brief for Congress, *Nuclear Energy Policy*, updated December 13, 2005.

[40] Energy Information Administration, *AEO 2006 Early Release*.

[41] Energy Information Administration, *AEO 2006 Early Release*.

2.2.1 Natural Gas and Power – Negative Effects

An important consequence of EPACT92 is the boom in electricity produced by natural gas-fired units. In fact, it has become the preferred fuel choice for new electricity generation facilities. This includes both baseload and intermediate power. The North American Electric Reliability Council defines baseload as the minimum amount of electric power delivered or required over a given period at a constant rate. EIA applies this concept to generating units, equating baseload to units that produce electricity at a constant rate and run continuously. Broken down further, baseload can be expressed as a percentage of capacity factor—the electricity actually produced compared to the potential electricity that the plant is capable of producing. Baseload is then the power supplied by units with a capacity factor of 70 percent or more, intermediate load refers to electricity supplied by units between plants used for only "peak" power needs—a capacity factor of 20 percent or less—and baseload at 70 percent.

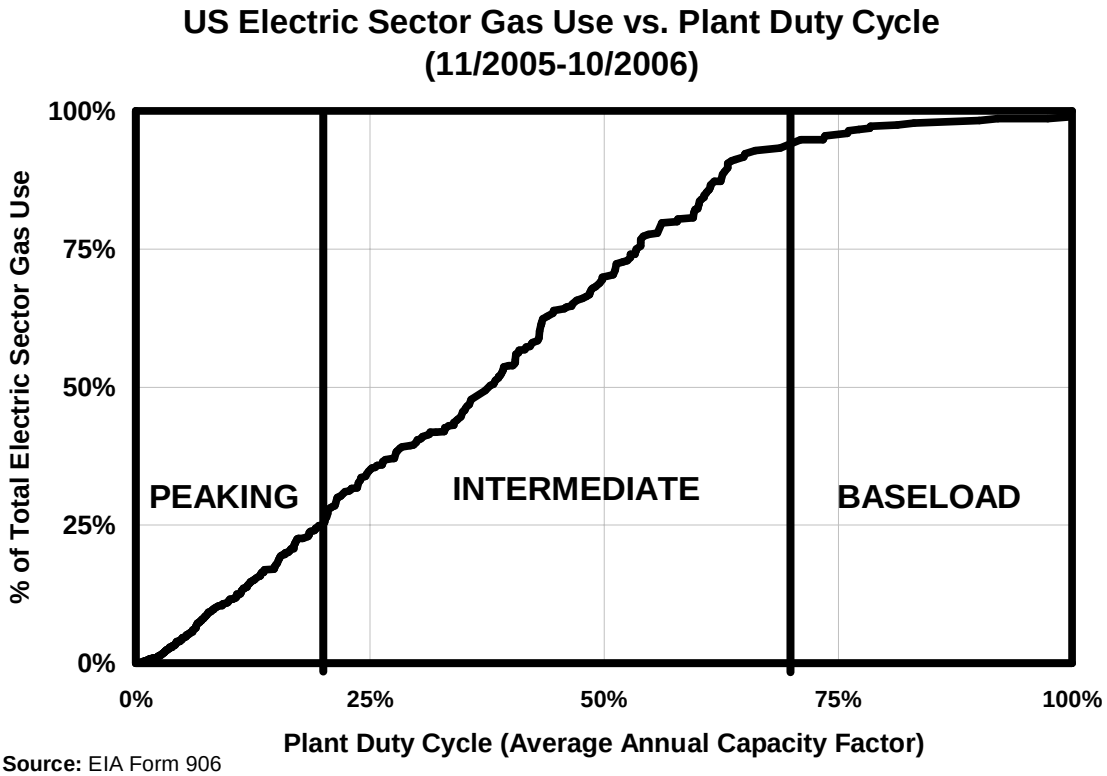
The Subcommittee staff is unaware of any comprehensive, US government analysis of baseload and intermediate power supplied by natural gas. According to EIA's definition and Subcommittee majority staff discussions with EIA, baseload can be assumed to be electricity that is supplied by nuclear and coal power plants.[42] This assumption is clearly flawed and discounts the largest source of new capacity. Natural gas clearly plays a large role in the country's intermediate and baseload power needs. Since the 1990s, almost all new plants are powered by natural gas, and the 5-year period from 1999 saw the largest increase in generating capacity in the electricity industry's history. From 1996 to 2000, the use of natural gas for electricity grew 11 percent ***per year***. According to EIA, of the 94,000 megawatts of planned additions in electricity generating capacity through 2009, 80 percent will be fueled primarily by natural gas, 14 percent by coal, and no new nameplate additions will be nuclear.

A capacity factor analysis initiated by the Subcommittee majority staff and completed by Cambridge Energy Research Associates for the November 2005-October 2006 period indicates that more than two-thirds of electricity generated by natural gas was intermediate power, and up to 5 percent was baseload power (see figure below).[43] The analysis examined a period when natural gas prices were at extremely high historical levels, which provided a strong disincentive for generators to burn natural gas for electricity. In fact, price incentives have never been higher to utilize existing coal and nuclear power plants to the maximum extent possible. For other years, such as 2002, the

[42] EIA generally defines baseload according to plants that run continuously. According to EIA, baseload capacity is defined as "the generating equipment normally operated to serve loads on an around-the-clock basis." A baseload plant is "a plant…which is normally operated to take all or part of the minimum load of a system, and which consequently produces electricity at an essentially constant rate and runs continuously."

[43] The analysis performed by Cambridge Energy Research Associates used data from EIA Form 906, which provides monthly and annual data on generation and fuel consumption at the individual power plant and prime mover level.

natural gas capacity factors were much higher—and baseload a larger share of natural gas supplied electricity—because the cost of natural gas was lower.[44] It is also important to note that the role of intermediate load has become more prominent since the bulk power markets were created by EPACT92. The significant swings in natural gas capacity factors and the cost of natural gas have a clear effect on the nation's electricity reliability, as well as the ability of households to meet their electricity bills.



Source: EIA Form 906

Courtesy of Cambridge Energy Research Associates

Natural gas has been especially attractive for use in electricity generation because natural gas plants are generally cleaner, less costly and faster to construct, easier to site and license, require less manpower to operate, and are fuel-efficient compared to alternatives. Rather than being a seasonal product with use spiking in the colder months, as was the case 25 years ago, natural gas demand is greater year-round because it has become the favorite choice for electricity generation. In addition to its use for electricity, natural gas heats more than half of American homes, and the number is increasing. In 2003, 70 percent of new homes built had heating systems fueled by natural gas.[45]

At the same time as natural gas has become the preferred fuel for electricity generation—and prices have reached a new and more expensive floor—industries that use natural gas as a feedstock or for primary energy have experienced grave consequences. Many

[44] In 2002, the average wellhead price was $2.95 per tcf, and the price was $7.51 per tcf for 2005.

[45] American Gas Association, *Snapshot of US Natural Gas Consumption (2005)*.

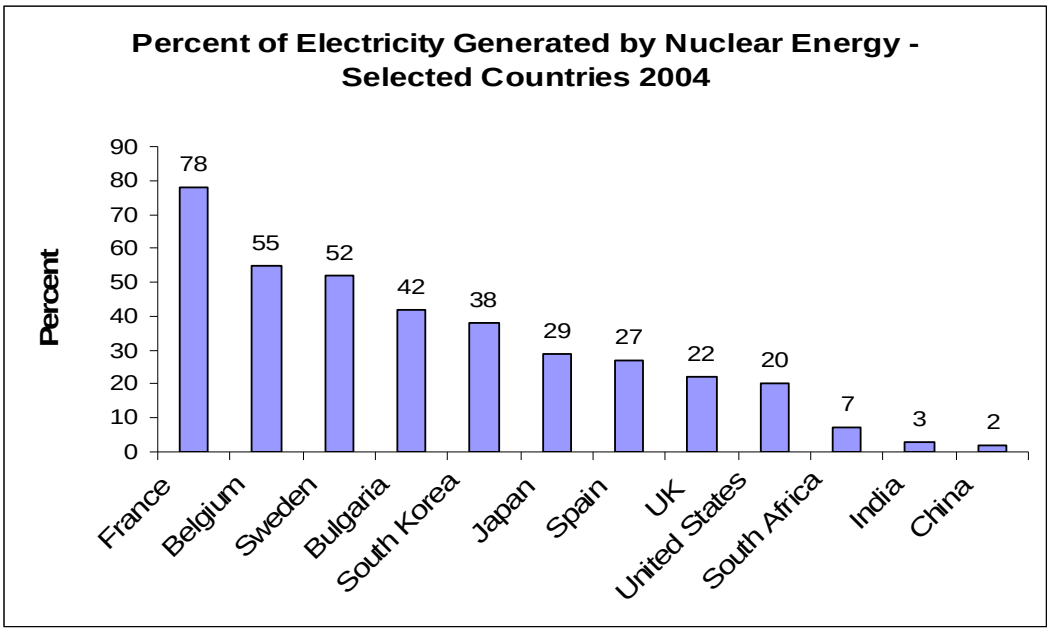
industrial users do not have the option of switching to other sources of fuel when natural gas prices rise. A 2001 price spike caused some industrial users to shut down production and sell their long-term natural gas contracts to make a profit, and it is likely that the price spike beginning in August 2005 has had the same effect. According to the Society of the Plastics Industry, as a direct result of a three-fold increase in natural gas prices the plastics sector lost more than 150,000 jobs and $14.6 billion in business to other countries from 2000 to 2002. As a result of high prices, America is no longer the world's top location for making chemicals; the US is now a net importer of chemicals. Ongoing high prices have also helped to shutter 21 nitrogen fertilizer production facilities, and production has moved overseas.[46] Natural gas should be exploited for the uses for which it is best suited. Profligate use of natural gas for electricity generation and other processes that can use other fuels will ultimately lead to the US being less competitive. Natural gas must not be squandered on baseload and new electricity generation.

2.3 Global Confidence in Nuclear Power is Growing

While the US struggles with these issues, nuclear power is moving ahead in other regions of the world. A March 2005 ministerial conference convened by the Organization for Economic Cooperation and Development concluded that nuclear power is a proven technology that contributes to the security of energy supply and the stability of energy prices by reducing exposure to fluctuations in the price of fossil fuels. In that regard, countries that once rejected nuclear power—such as Germany and Italy—are beginning to revise their policies. Even in Sweden—where a referendum in the 1980s placed a moratorium on nuclear power—public opinion polls indicate that 77 percent favor continued nuclear generation.[47]

[46] Testimony of Mr. Ford B West, President of the Fertilizer Institute, before the Senate Appropriations Interior and Related Agencies Subcommittee, October 25, 2005.

[47] *The Analysis Group*, November 2005 telephone poll of 2062 Swedes.



Source: Compiled from World Nuclear Association tables, June 2005.

Moreover, as China and India develop, their energy demand is projected to skyrocket. In light of serious air quality problems and challenges transporting coal to its population centers, industry observers report that China plans to commission 21 new plants between now and 2020, increasing the number of reactors in operation from 9 to 30. Furthermore, the World Nuclear Association recently reported that India's national energy policy calls for increasing the country's 2.5 gigawatt nuclear generating capacity one hundred-fold by 2050.

France's heavy investment in nuclear power has positioned the country's state-owned power groups to reap significant benefits from marketing new nuclear technologies. The *Financial Times* reported in late March 2005 that corporate forecasts estimate that some $261 billion will be spent between 2010 and 2030 on building and updating reactors in Europe alone. The French government estimates that nuclear power not only saves the country about $13.3 billion annually when compared with the costs of generating electricity from natural gas, but that the industry's annual exports are worth $33 billion.[48] France is the world's largest net electricity exporter, and nuclear generated electricity is France's fourth largest export.[49] In addition, France recently announced that it aims to have a new generation of reactors constructed and operating by 2020. Finland also finalized a contract with one of France's two power groups to build the first of a new generation of nuclear power plants, the European Pressurized Water Reactor, and China is considering the same reactor type for its electricity needs.

[48] Peggy Hollinger, "France Wins Support as Showcase for Nuclear Power," *Financial Times*, 3/21/05, p. 3. US dollar figures are converted from Euros based on the exchange rate on the date of publication.

[49] World Nuclear Association, *French Nuclear Power Program Issue Brief*, February 2006.

2.4 Nuclear Power and the US

Nuclear power plants currently generate a significant amount of the nation's electricity baseload. Projected growth in electricity demand, volatile fossil fuel prices, and environmental concerns have revitalized interest in nuclear generation in the US and elsewhere in the world. Nuclear power is a proven, emission-free source of electricity that can contribute to the security of energy supplies and the stability of prices.

Today's operating nuclear power plants are consistent high performers in the US electricity generation system, accounting for 20 percent of the nation's electricity. The US nuclear power industry comprises 103 licensed reactors at 65 plant sites in 31 states.[50] Electricity production from US nuclear power plants is greater than that from oil, natural gas, and hydropower, and behind only coal, which accounts for more than half of US electricity generation. Nuclear plants generate more than half the electricity in six states. The record 824 billion kilowatt-hours of nuclear electricity generated in the United States during 2004 was more than the nation's entire electrical output in the early 1960s, when the first large-scale commercial reactors were being ordered.[51] Nuclear plants have proven to be extremely reliable and clean.

2.4.1 A Record Of Reliable and Efficient Power

Since the early 1990s, US nuclear generators have dramatically increased their capacity factor from about 70 percent to over 90 percent in 2004—the equivalent of gaining the output of about 25 nuclear power plants without building a single new facility.[52] Nuclear plants have also produced power with stable, predictable operating costs that are relatively insulated from price fluctuations. Now that they are fully depreciated, the average US nuclear power plant now generates electricity at about 1.5 cents per kWh—far below the average US retail price for electricity, slightly less than coal, and much less than natural gas (2.5 cents/kWh before the record increase in prices in 2005).[53] Electricity production costs are a function of the costs for fuel, operations and maintenance, and capital. Fuel costs make up most of the operating costs for fossil-fired units.[54] To illustrate the impact of high natural gas prices, fuel costs for the US power

[50] This excludes TVA's Browns Ferry 1, which has not operated since 1985; the TVA Board decided May 16, 2002, to spend about $1.8 billion to restart the reactor by 2007.

[51] Congressional Research Service, *Nuclear Energy Policy*, updated April 15, 2005, p. 2.

[52] Statement of the Honorable Clay Sell, Deputy Secretary, Department of Energy, before the Senate Committee on Energy and Natural Resources, April 26, 2005.

[53] Paul Portney, "Nuclear Power: Clean, Costly and Controversial," *Resources*, Winter 2005, p. 29. According to the Nuclear Energy Institute, the cost of electricity produced from natural gas in February 2005 was 5.8 cents/kWh.

[54] Even with waste disposal costs accounted for, the total fuel costs of a nuclear power plant in OECD countries are typically about one-third of those for a coal-fired plant, and between 20 and 25 percent of

sector rose from $68 billion in 2004 to $92 billion in 2005, according to a briefing by Cambridge Energy Research Associates. Fuel costs are a much smaller portion of total production costs for nuclear units and, therefore, nuclear power is much less sensitive to the type of spikes recently seen in the price for natural gas.

Electricity generated by nuclear power plants stabilizes the nation's electricity markets. Nuclear power is likely to remain one of the most reliable energy sources because operational costs are known, steady, and predictable. Unlike fossil fuels, the availability and cost of uranium are stable and not likely to fall prey to cartels, embargoes, or price volatility. In the absence of an aggressive effort to expand the role of nuclear power, forecasts call for a rapid development of natural gas generating capacity which will require a dramatic increase in importation of natural gas from overseas sources—a market that seems likely to resemble that for petroleum in the not-too-distant future, with prices being set in a tight world market and supplies being widely transported around the globe. The market for the uranium that fuels power plants benefits from a relatively abundant and secure supply in North America.

The nuclear industry in the US can also point to decades of safe operation. By many measures, the industry has achieved a remarkable safety record. The safety and operational performance of the US nuclear industry has been setting new records, with most indicators exceeding the goals set in 2000, according to performance data analyzed by the Institute of Nuclear Power Operations, a nonprofit, independent technical organization formed by the US nuclear utility industry in late 1979. In particular, the median number of unplanned automatic shutdowns has been zero for the industry the last nine years—except for 2003 when the August 14 blackout caused nine plants to shut down—reduced from a median of 7.3 *per plant* in 1980.[55]

2.4.2 Nuclear Power's Environmental Benefits

Perhaps most importantly, nuclear generation contributes considerable air quality benefits to the nation. Unlike electricity generated from coal and natural gas, nuclear energy does not result in any emissions of conventional air pollutants, such as nitrogen oxide and sulfur dioxide, carbon dioxide or ever-toxic methylmercury. According to the Clean Air Council, annual power plant emissions are responsible for 36 percent of carbon dioxide (CO_2), 64 percent of sulfur dioxide (SO_2), 26 percent of nitrogen oxides, (NOx) and 33 percent of mercury (Hg) emissions. While only 58 percent of power plant boilers in operation in the US are fueled by coal, they contribute an astounding 93 percent of NOx, 96 percent of SO_2, 88 percent of CO_2, and 99 percent of Hg emitted by the entire power

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those for a gas combined-cycle plant; Uranium Information Centre, "The Economics of Nuclear Power," Briefing Paper 8, April 2006.

[55] Nuclear Energy Institute, "The TMI 2 Accident: Its Impacts, Its Lessons (Factsheet), March 2004; NEI, "Nuclear Energy Industry Maintains Near-Record Levels of Safety and Operating Performance," April 3, 2006.

industry.[56] By substituting for fossil fuel plants, nuclear energy prevented the emission of an estimated 1.11 million tons of nitrogen oxide, 3.43 million tons of sulfur dioxide, and 696.6 million metric tons of carbon dioxide in 2004 alone.[57]

Furthermore, any discussion of policy options to deal with global warming and climate change must acknowledge the centrality of nuclear power's role as a solution. A few renowned environmentalists like James Lovelock have exposed the hypocrisy of fringe groups that claim climate change is the greatest threat to civilization and must be addressed now, but steadfastly refuse to admit nuclear energy must be part of the solution. The American public is belatedly recognizing this fact. According to a March 2006 Gallup poll, 55 percent of the public supports expanding the use of nuclear power, including a majority of Democrats.

2.4.3 Nuclear Power: The Financial Challenge

Despite nuclear power's advantages, including competitive operating costs, financial challenges stand in the way of new plant construction. According to the Congressional Research Service, construction costs for reactors completed since the mid-1980s ranged from $2 to $6 billion, averaging more than $3,000 per kilowatt of electric generating capacity (in 1997 dollars). The nuclear industry predicts that new plant designs could be built for less than half that amount if many identical plants were built in a series, but such economies of scale have yet to be demonstrated.[58]

In addition, building the first new nuclear power plant in the US in decades is regarded as a high-risk effort by both the nuclear power industry and the financial community. These reservations exist despite the fact that reactor designs have been standardized, and these uniform designs have been constructed and are in operation around the world. The industry's reluctance is largely based on past experience in the US. Several of the nation's currently operating nuclear plants experienced delays due to changing regulations, lengthy litigation (often brought by groups whose opposition to any nuclear power is absolute), and significant cost overruns that seriously impacted the financial health of the utilities and investors engaged in the projects.

Nuclear power's checkered financial history means that both debt and equity investors will be extremely cautious before undertaking the financing of new nuclear construction. The major risk for lenders is a delay in operations—hence revenues—by factors such as those experienced in the past. Unless this risk is mitigated, sufficient debt financing to support new nuclear plant construction will likely not be made available. Equity investors also look to the predictability of a company's projected earnings and cash flows

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[56] Written testimony of Mr. Patrick Moore for the April 28, 2005, Subcommittee hearing entitled, "The Role of Nuclear Power Generation in a Comprehensive National Energy Policy," p. 4.

[57] Nuclear Energy Institute briefing, March 2006.

[58] Congressional Research Service, *Nuclear Energy Policy*, Updated March 15, 2006, p. 2.

to ultimately determine whether to invest. Because investment in nuclear power plants would be viewed by investors as quite risky, the market would probably demand very high returns. Congress and the Administration must send a very clear message to the market that nuclear power will be supported for the long-term and additional incentives will be forthcoming.

2.4.4 Nuclear Waste and Closing the Fuel Cycle

A continued focus must remain on securely storing spent fuel and resolving the situation at Yucca Mountain. The Secretary of Energy Advisory Board's Nuclear Energy Task Force reported that concern over whether nuclear waste can be safely managed is diminishing in scientific and technical communities. Surface storage of spent nuclear fuel can be undertaken with adequate safety for many decades. There is general agreement in the scientific and technical community that disposal in a deep geologic repository is achievable, and that such disposal provides an effective long-term means of isolating spent fuel from the environment—and additional options may be feasible.[59]

However, Yucca has suffered a number of setbacks. It was originally slated to open in 1998, but the Department of Energy now forecasts it to receive waste in 2012—even though it will be filled to its maximum capacity by waste generated up to 2010.[60] In addition, in July 2004 a court ruled that the EPA's 10,000-year regulatory compliance period for the facility was too short and should have been in line with National Academies of Science recommendations for a standard of at least 300,000 years.[61] In response, EPA has proposed a new standard, but this may be an opportunity for Congressional determination of the time standard because it is clear that the NAS recommendation does not account for technological progress that will be made in the future. Regardless of whether an operational, licensed repository for spent fuel is in place or if construction of additional nuclear generation capacity begins in earnest, the issues associated with disposal of spent fuel will need to be resolved.

There are additional opportunities to address the waste situation. While a long-term storage and disposal facility must be part of the solution, reconsideration of the "once-through" fuel cycle must be on the agenda. The reprocessing of nuclear fuel is more efficient, decreases the volume of waste, and results in less harmful waste that must ultimately be disposed of in a long-term waste facility. The goal should be to develop the technology to ultimately close the fuel cycle.

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[59] See Secretary of Energy Advisory Board, *Moving Forward with Nuclear Power: Issues and Key Factors – Final Report of the Secretary of Energy Advisory Board Nuclear Energy Task Force*, January 10, 2005.

[60] Congressional Research Service, *Civilian Nuclear Waste Disposal*, Updated February 24, 2006, p. 2, 5.

[61] Mary O'Driscoll, "Yucca Mountain: Court rules site selection legal but remands EPA safety standard," *Greenwire*, July 12, 2004; Suzanne Struglinski, "Yucca in for long delay; radiation standard too low," *Las Vegas Sun*, July 9, 2004.

The US operates a once-through nuclear fuel cycle based on a decades-old decision that reprocessing would be uneconomical for the long-term and the recycling of plutonium would be too much of a risk to nuclear proliferation. The US has stuck to a fuel cycle in which the uranium-based fuel is used once and then destined for a geologic repository. However, other countries, such as France, Japan, and Russia, have preferred to extract and recycle the fissile material from spent fuel to increase the energy produced by each kilogram of uranium extracted from the ground, and also to reduce the volume and toxicity of the final waste product.[62] The US approach has proven less costly in absolute terms because the price of uranium has remained relatively cheap and stable. However, the decision has been a double-edged sword because the disposal problem is still not resolved even though work on Yucca Mountain began in 1987. Another rationale for the once-through cycle is that US leadership in nuclear non-proliferation efforts would be weakened if the US were to engage in fuel reprocessing. This is a dubious argument at best since other countries have pursued nuclear programs with weapons capabilities regardless of the US position on reprocessing—and regardless of the Japanese, French, and British reprocessing programs.

An innovative reprocessing initiative must include a significant increase in funding to develop more advanced technologies, make reprocessing more economical, and address proliferation concerns. Options to counter proliferation threats could include new security measures, consolidation of fuel enrichment facilities so that most countries will not have the need to manufacture or reprocess their own fuel, and the establishment of international waste repositories.

In 2006, the President has forcefully advanced closing the fuel cycle with a bold strategy to comprehensively address emissions, waste, and proliferation issues through the Global Nuclear Energy Partnership (GNEP). The investment required will be significant and deserves the utmost consideration by Congress considering the implications for future US energy security.

[62] World Nuclear Association, "Processing of Used Nuclear Fuel for Recycle," December 2005.

Conclusion

US policymakers must rise to the challenge of breaking the chains of energy dependence by first acknowledging that the global energy situation has fundamentally and irreversibly changed. Unlike previous episodes of high energy prices, the current situation is fundamentally different because it is demand-driven. We must face the fact that no matter what we do to secure sources of supply for petroleum, the US can do relatively little in terms of lowering oil prices over the long haul because oil is bought and sold on a world market. It is possible that oil and energy prices will decrease if a recession were to occur in the US and Asia, or as a result of a spike in new exploration and production of oil and natural gas.

However, the price effect would be temporary because the structural issues for demand will remain the same. Over the long-term, energy demand will continue to rise from both the developed and developing world, particularly Asia. Additionally, the geopolitical issues that surround the availability of oil and natural gas imports to consuming countries from producing countries—Iran, Russia, Venezuela, Saudi Arabia, Nigeria, or others—have the potential for catastrophic consequences for the US economy and vital national security interests.

There is only one way to guarantee the national security and economic well-being of the American people. A comprehensive plan must be developed to reach increasing levels of energy independence, and we must not waver in our commitment to seeing it realized even if prices are to temporarily drop. As witnessed from events of the last 35 years, energy dependence and the effects of comparatively rare supply shocks made us ***more*** dependent on imported petroleum resources because policymakers put the priority on lowering prices of suddenly scarce commodities to avoid abrupt economic hardship. Once the price of oil and gasoline dropped, the impetus for a profound and long-lasting change in US energy supply and consumption patterns was lost. This is demonstrated by the fact that the US is more dependent on imported oil than in the past despite the periodic calls for national initiatives to wean our appetite for foreign crude in the wake of the 1973 Arab Oil Embargo, the 1979 Iranian Revolution, and the Iraqi invasion of Kuwait and the Persian Gulf War in 1990-1991. We must ensure that the current geopolitical situation and the lessons of Hurricanes Katrina and Rita are not added to this ignominious list of opportunities lost.

To set foot down the path of energy independence, the US must first address the transportation sector because it is the predominant user of crude oil and refined petroleum products. Implementing a market-based system of stronger CAFE standards will help achieve this goal while making American industry more competitive in the global

marketplace. Second, emissions-free nuclear power must become the primary source of baseload electricity and the choice for new units to generate electricity. Our reliance on natural gas as the preferred source of fuel for new electricity generation has put us in a precarious position both economically and geopolitically.

Policymakers must be realistic about our ability to break the chains of energy dependence, the actions required, and the consequences if those actions are not taken. Energy consumption in the US must be viewed in terms of an energy portfolio, which includes not just choices of fuels but the full gamut of measures to be taken. We cannot ignore empirical reality by engaging in dangerous wishful thinking. We cannot conserve our way to energy independence, nor domestically produce enough oil and natural gas to make the geopolitical importance of the Middle East a distant memory. It is time policymakers make these difficult choices.

Appendix

Subcommittee on Energy and Resources, Hearings on Energy– 1st Session, 109th Congress

March 16, 2005 – *Energy Demand in the 21st Century: Are Congress and the Executive Branch Meeting the Challenge?*

Witnesses: Mr. Jim Wells, Director, Natural Resources and Environment, Government Accountability Office

Mr. Guy Caruso, Administrator, Energy Information Administration, Department of Energy

Mr. Paul Portney, President, Resources for the Future

April 6, 2005 – *America's Energy Needs as Our National Security Policy*

Witnesses: The Honorable Jeffrey Clay Sell, Deputy Secretary, Department of Energy

The Honorable R. James Woolsey, former Director of the Central Intelligence Agency

Ambassador Robert Hormats, Vice Chairman, Goldman Sachs International

Mr. Robert E. Ebel, Chairman, Energy Program, Center for Strategic and International Studies

April 28, 2005 – *The Role of Nuclear Power Generation in a Comprehensive National Energy Policy*

Witnesses: Mr. Donald Jones, Vice President and Senior Economist, RCF Economic and Financial Consulting, Inc.

Mr. Marvin Fertel, Senior Vice President for Business Operations, Nuclear Energy Institute

Mr. Patrick Moore, Chairman and Chief Scientist, Greenspirit Strategies Ltd.

May 9, 2005 – Field Hearing, Long Beach, CA – *What's Causing Record Prices at the Pump?*

Witnesses: Mr. John Cook, Director of the Petroleum Division, Office of Oil and Gas, Energy Information Administration, Department of Energy

Mr. Jim Wells, Director, Natural Resources and Environment, Government Accountability Office

Mr. Pat Perez, Transportation Energy Division, California Energy Commission

Ms. Rayola Dougher, Manager, Energy Market Issues, American Petroleum Institute

June 8, 2005 – *Ensuring the Reliability of the Nation's Electricity System*

Witnesses: The Honorable Pat Wood III, Chairman, Federal Energy Regulatory Commission

Mr. Michehl R. Gent, President and CEO, North American Electric Reliability Council

Mr. David Owens, Executive Vice President, Edison Electric Institute

Dr. Mark Cooper, Director of Research, Consumer Federation of America

June 29, 2005 – *The Next Generation of Nuclear Power*

Witnesses: Mr. Robert Shane Johnson, Acting Director, Nuclear Energy, Science and Technology, Department of Energy

Dr. David Baldwin, Senior Vice President, General Atomics

Dr. Rowan Rowntree, Independent Scientist

Mr. Dave Lochbaum, Nuclear Safety Engineer, Union of Concerned Scientists

July 27, 2005 – *The Hydrogen Economy: Is it Attainable? When?*

Witnesses: The Honorable Douglas L. Faulkner, Acting Assistant Secretary for Energy Efficiency and Renewable Energy, Department of Energy

The Honorable Richard M. Russell, Associate Director for Technology, Office of Science and Technology Policy, Executive Office of the President

The Honorable Alan Lloyd, Secretary, California Environmental Protection Agency

Mr. Dennis Campbell, CEO, Ballard Power Systems

Lawrence D. Burns, Vice President of Research and Development, General Motors Corporation

Mr. Mujid Kazimi, Director, Center for Advanced Nuclear Energy Systems, Massachusetts Institute of Technology

Mr. Daniel Sperling, Director, Institute of Transportation Studies, University of California at Davis

September 14, 2005 – *Meeting America's Natural Gas Demand: Are We in a Crisis?*

Witnesses: The Honorable Rebecca Watson, Assistant Secretary for Land and Minerals Management, Department of Interior

The Honorable Guy Caruso, Administrator, Energy Information Administration, Department of Energy

Mr. Michael Zenker, Senior Director, North American Natural Gas, Cambridge Energy Research Associates

Mr. Logan Magruder, President, Independent Petroleum Association of Mountain States

Mr. Tyson Slocum, Research Director – Energy Program, Public Citizen

October 19, 2005 – *Petroleum Refineries: Will Record Profits Spur Investment in New Capacity?*

Witnesses: Mr. Bob Slaughter, President, National Petrochemical & Refiners Association

Mr. Paul Sankey, Senior Energy Analyst, Deutsche Bank AG

Mr. Tom O'Connor, Project Manager, ICF Consulting

Mr. Eric Schaeffer, Director, Environmental Integrity Project

Additional information and hearing testimony are available on the Subcommittee's website http://reform.house.gov/ER/ .